Due on May 12th 2020 (11:00 am)

NAME: _____ **MAXIMUM POINTS: 100**

ECE 322L: Electronics-II (Spring 2020, University of New Mexico)

FINAL EXAMINATION

INSTRUCTIONS:

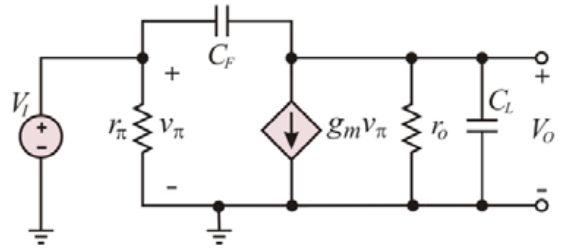
- Write your name on the top left corner
- Write your answers on separate sheets of paper
- Specify the question id (e.g., Q1) on the separate sheets of paper that you are using to provide your answers

Each question is worth 4 points. In order to receive full credit, you will have to concisely justify your answers.

Q1. Consider a forward-biased Si diode with I_D=1 mA. Next, I_D is increased to 10 mA. Circle the true statement below.
(a) The diffusion capacitance C_d decreases and junction capacitance C_j increases.
(b) The diffusion capacitance C_d increases and junction capacitance C_j decreases.
(c) Only the diffusion capacitance C_d increases.
(d) Only the junction capacitance C_j increases.

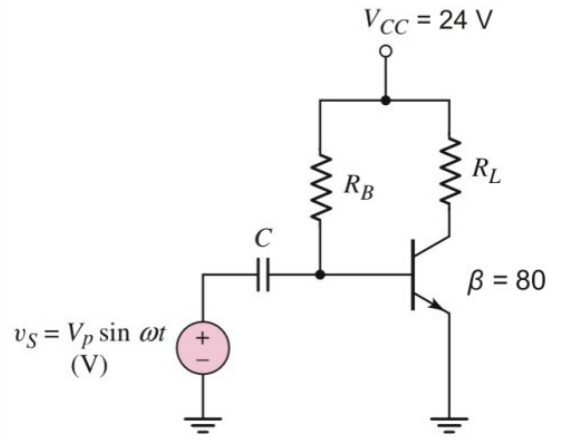
Q2. (True/False) BJTs and MOSFETs are two electrically symmetrical devices, i.e. one can, in principle interchange the drain (collector) and the source (emitter) terminals without affecting device behavior.

Q3. Which capacitor yields the dominant upper corner frequency in the circuit below? Circuit parameters are r_π=2.5 KΩ, r_o=100 KΩ, g_m=40 mS, and C_L=C_F=1 nF?



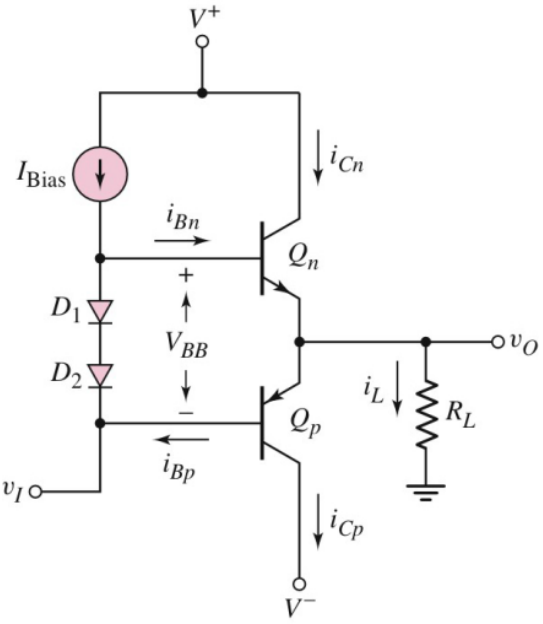
Q4. Would you select a large or a small BJT to amplify a high frequency signal?

Q5. What is the frequency response of the amplifier below?
(a) High-pass
(b) Low-pass
(c) Band-pass.



Q6. (True/False) The diffusion capacitance of a pn junction is negligible when the junction is reverse-biased.

Q7. Write down one phrase/sentence that describes the purpose of the diodes and constant current source in the amplifier below.



Q8. Any damage to a power transistor is prevented if the _____ lays _____the SOA.

Q9. The output stage of a voltage amplifier
(a) is typically a source/emitter follower.
(b) often includes a power transistor
(c) has low output resistance
(d) All of the above.

Q10. A BJT has rated power of 115 W at $T_{case}=25^o$ C and maximum allowable junction temperature $T_{j,max}= 200^o$ C . The transistor is dissipating 5 W at an ambient temperature $T_A=25^o$ C. As it is required to operate the BJT at 60^o C, a heat sink is needed. Which heat sink would you select?

(a) One with a $\theta_{case\text{-}sink}=1^o$ C/W and a $\theta_{sink\text{-}ambient}=4^o$ C/W

(b) One with a $\theta_{case\text{-}sink}=4^o$ C/W and a $\theta_{sink\text{-}ambient}=10^o$ C/W

(c) $\theta_{case\text{-}sink}=1^o$ C/W and a $\theta_{sink\text{-}ambient}=1^o$ C/W

(d) More information is needed to appropriately select a heat sink.

Q11. (True/False) The maximum safe power dissipation in a device is directly proportional to the temperature difference between the device and the ambient.

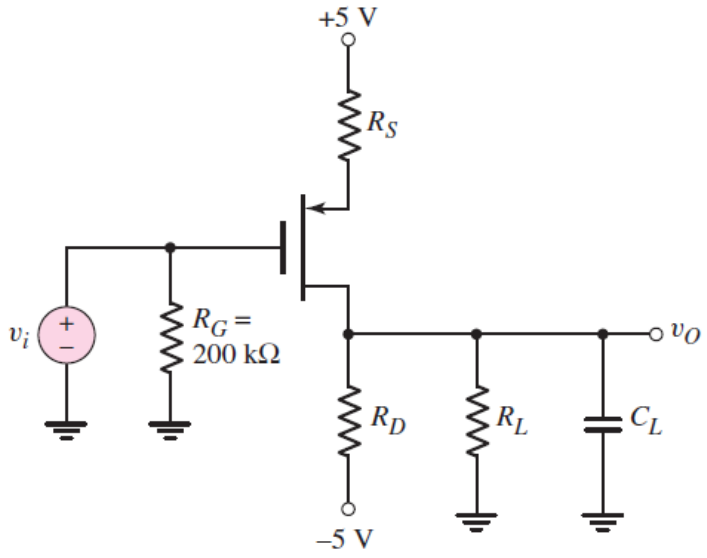
Q12. (True/False) Inserting a bypass capacitor in a common emitter amplifier circuit will decrease the upper corner frequency of the amplifier.

Q13. Name one amplifier configuration whose performance is not limited by the Miller effect.

Q14. Assume you are process engineer with the assigned task to reduce the Miller effect in a MOSFET. What is your strategy?

Q15. In an npn BJT, C_μ _____at increasing V_{CE}.

Q16. Sketch the frequency response of the amplifier below.



Q17. (True/False) For a MOSFET in saturation $C_{gs}=C_{gd}$.

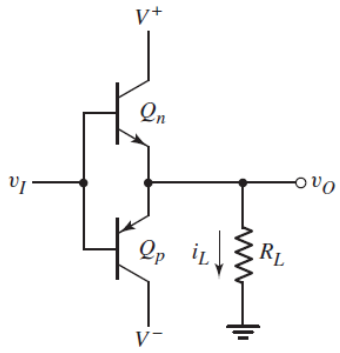
Q18. Assume your output signal suffers from cut-off clipping. Would you move your Q point up or down the ac load line, in order to avoid this distortion?

Q19. Why is a class A amplifier so inefficient?

Q20. Sketch the collector current of a pnp in a class AB push-pull-stage.

Q21. In a npn operating in saturation mode C_μ is a_____ capacitance.

Q22. Sketch and label the voltage-transfer-characteristic of the stage below for values of the $v_{CEn} > V_{CE,sat}$ and the $v_{ECp} > V_{EC,sat}$.



Q23. (True/False) A Darlington pair can be implemented using MOSFETs to obtain a very high current gain at midband.

Q24. (True/False) At increasing ambient temperature the SOA of a transistor remains unchanged.

Q25. (True/False) Using a BJT with a large-area B-C junction will reduce the Miller effect in a CE amplifier.